REMARKS

This is in response to the Office Action dated April 18, 2007. In view of the foregoing amendments and following representations, reconsideration is respectfully requested.

Initially, on page 2 of the Office Action, the disclosure is objected to because the Examiner indicates that, on page 19, line 6, "10^{8}" should be --10^{-8}--. However, it is submitted that the specification, as originally filed, is correct. In support of this assertion Applicants submit herewith the following documents (only relevant pages enclosed):

Exhibit 1. "SEMICONDUCTOR ELEMENT", Tetsuro ISHIDA and Higashi SHIMIZU, issued by Corona Publishing Co., Ltd., May 15, 1982 (see Fig. 1.2 showing volume resistivities of various substances at room temperature of chapter 1.1 Conductor); and

Exhibit 2. "BASIC THEORY OF SEMICONDUCTOR", Atsuo HOTTA, issued by Gitjutsu-Hyohron Co., Ltd., October 10, 2000 (see Fig. 1.2 volume resistivity of semiconductor in item 1.1 "semiconductor definition" of chapter 1 "semiconductor physics and PN junction").

Note that lines 1-2 of page 13 of the second document explain that "in metal, the value of the volume resistivity is $\approx 10^{-6}\,\Omega\cdot$cm to $\approx 10^{18}\,\Omega\cdot$cm."

Accordingly, it is submitted that the range recited in the specification is correct. The Examiner is therefore is requested to withdraw this objection to the specification.

Next, on pages 2-3 of the Office Action, claims 13-30 are rejected under 35 U.S.C. § 112, second paragraph. Accordingly, the claims have been amended to avoid the language considered indefinite by the Examiner. In particular, the term "vicinity" in claims 13 and 22 has been changed to –a range of about 10000 Pa to about three atmospheres--. Support for this amendment can be found at least on page 19, line 12; page 27, line 17; page 33, line 16; page 36; line 9; page 39, line 6;

page 44, line 11; page 48, line 12, page 52, line 8, page 55, line 2, and page 58, line 2 of the specification as originally filed.

Claims 16 and 25 have been amended to change the term "close" to --wherein the distance between the plasma source and the object to be processed is within a range of 0.05 mm to 0.5 mm--. Support for this amendment can be found at least on page 62, lines 22-24 of the specification as originally filed. Claims 15, 16 and 24 have been amended to change the term "microelectrodes" to --electrodes--. With respect to claims 21 and 30, the language "CxFy (x and y are natural numbers) such as SF_6, and NF_3, O_2, Cl_2, or a halogen containing gas of HBr" has been changed to –CxFy (x and y are natural numbers) or NF_3, O_2, Cl_2, or a halogen containing gas of HBr--. This change adopts the Examiner's helpful suggestion.

In view of the above amendments, it is submitted that the claims are now clearly in compliance with the provisions of 35 U.S.C. 112, second paragraph.

* * * * *

Next, on pages 4-5 of the Office Action, the claims are rejected as follows:

Claims 13-16, 19, 22-25 and 28 are rejected under 35 U.S.C. 102(b) as being anticipated by Beisswenger et al. (U.S. Patent No. 5,102,523);

Claims 13-19 and 22-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Hasagawa et al. (U.S. Patent No. 6,497,839); and

Claims 20, 21, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Beisswenger.

It is submitted that the present invention, as defined in the amended claims, now clearly distinguishes over the Beisswenger and Hasagawa references for the following reasons.

The present invention, as defined in independent claims 13 and 22, recites a plasma processing method in which the electric potential of a plurality of electrodes are selectively and independently controlled so as to generate plasma in a desired configuration on an object to be processed.

According to the claimed process, it is possible to process an object with plasma in a desired arbitrary configuration (configuration to be processed) by employing a simple plasma source. Please see the excellent effects of the present invention which are described on page 63, line 16 to page 76, line 1 of the specification. For example, as described on page 64, line 22 to page 65, line 5:

"*By arranging the potentially controlled electrode in the position opposite to the plasma source via the object to be processed and processing a part of the object to be processed, the object can be processed in the desired arbitrary configuration with a plasma by a simple plasma source without using a mask such as a resist.*"

Also, lines 3-14 of page 66 state that:

"*By arranging the electrode, which is constructed of the plurality of dot-shaped microelectrodes in the position opposite to the plasma source via the object to be processed and is potentially controlled and selectively bringing an arbitrary microelectrode(s) close to the object to be processed, the object can be processed in the desired arbitrary configuration with a plasma by a simple plasma source without using a mask such as a resist, and the object can be*

processed in several kinds of configurations with a plasma over a wide range by one electrode without scanning the plasma source or the electrode."

In contrast, as explained below, each of the applied prior art references fails to disclose or suggest a plasma processing method that could provide the advantages realized by the movement or potential control of the electrodes.

Beisswenger discloses a plasma processing device which includes an electrode 22 electrically connected with a high-frequency generator 25, and an opposing electrode 28 connected to the second terminal of high-frequency generator 25. The opposing electrode, which actually includes opposing electrode 28, pipes 39-45 and metal plate 46, can be raised and lowered (see col. 4, lines 13-17). This movement causes a change of electrode surface area because the surface area is formed by metal plate 46 and the external surfaces of pipes 39-45. Thus, a lowering of the opposing electrode 28 effects an enlargement of the electrode surface area while raising the electrode 28 causes a decrease of the electrode surface. The object of the Beisswenger apparatus is the uniform application of a large-area static coating. However, since the Beisswenger electrode moves as a single unit, the movement changes the surface area of the electrode which effects the layer applied over the <u>entire</u> surface of the substrate. Thus, since the Beisswenger electrode does not have plural electrodes that can be individually moved toward and away from the substrate, it clearly cannot process the object so as to form plasma in a desired configuration without using a mask such as a resist. Accordingly, it is submitted that the Beisswenger apparatus does not meet each and every limitation of claim 13 or claim 22.

Hasegawa discloses a sterilizer and a sterilization method which employs a power supply

section for generating a high voltage in a processing device having a discharge side electrode 3 and a ground side electrode 4. It is not clear what application the Hasegawa sterilization device would have in the environment of a plasma processing device.

The Examiner takes the position that Hasegawa discloses an "array" of electrodes with a variable distance between the discharge side electrode and the objects to be sterilized. However, the discharge side electrode does not appear to be comprised of a plurality of electrodes which are independently and selectively movable toward and away from the substrate. Further, in the Hasegawa device, the discharge electrode 3 is connected to lift means 12 so that the electrode can be vertically moved relative to the ground side electrode 4. Clearly, there is no disclosure in the Hasegawa reference that could be read on the language of claims 13 and 22 requiring independent and selective control of a plurality of electrodes in order to process an object with a plasma in a desired configuration. Therefore, it is submitted that the Hasegawa reference does not meet each and every limitation of independent claim 13 or independent claim 22, and therefore Hasegawa cannot anticipate these claims under 35 U.S.C. 102(b).

In view of the above, it is submitted that the present application is now clearly in condition for allowance. The Examiner therefore is requested to pass this case to issue.

In the event that the Examiner has any comments or suggestions of a nature necessary to place this case in condition for allowance, then the Examiner is requested to contact Applicant's undersigned attorney by telephone to promptly resolve any remaining matters.

Respectfully submitted,

Mitsuo SAITOH et al.

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September 18, 2007

Revised
"Semiconductor element"

改訂 半導体素子

工学博士 石田哲朗
工学博士 清水　東 共著

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標準電気工学講座

コロナ社

Exhibit 1

記 号	倍 数
m	10^{-3}
μ	10^{-6}
n	10^{-9}
p	10^{-12}

第 1 章

半導体とその種類

本書で取り扱おうとしているダイオード・トランジスタ・太陽電池・半導体レーザ・ホール素子その他の素子は半導体で作られている．そこで，まず半導体の性質や種類を簡単に述べ，また，半導体工学で使われる基礎的な用語について説明しよう．

1·1　導体・半導体および絶縁物

物質を電気伝導の点から大別すれば，導体・半導体および絶縁物に分けられ，その一例を抵抗率の順に並べると図 1·1 のようになる．**導体** (conductor) とは，電圧を加えたとき電流が流れやすい物質をいう．金属はすべて良導体であって，抵抗率がおよそ $10^{-4}\,\Omega\cdot\mathrm{cm}$ 以下の物質は導体すなわち金属とみてよい．温度の上昇とともに抵抗率が高くなるのが金属の特徴である．**絶縁物** (insulator) とは，金属に比べて電流がきわめて流れにくいものをいい，抵抗率が $10^{10}\,\Omega\cdot\mathrm{cm}$ 程度以上の材料である．金属と異なり，温度が上昇すれば抵抗率は減少する．金属と絶縁物の中間の抵抗率を有する物質を，これらの中間の

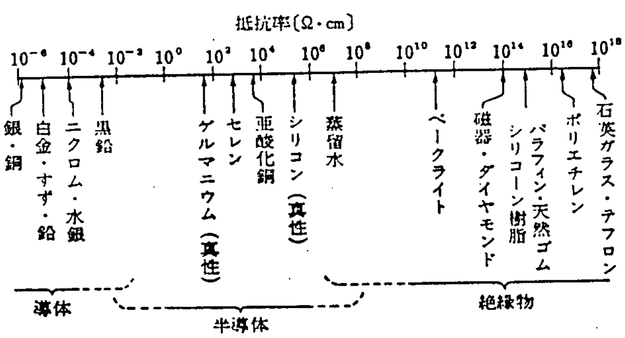

図 1·1　種々の物質の室温における抵抗率
Fig. 1.1

Revised "SEMICONDUCTOR ELEMENT"
Tetsuro ISHIDA, and Higashi SHIMIZU
issued by CORONA PUBLISHING CO., LTD.

1.1 Conductor · semiconductor and insulator

Resistivity (Ω·cm)		
10^{18}		
	quartz glass & teflon®	
	polyethylene resin	
10^{16}		
	paraffin & natural rubber &	
	silicone resin	
10^{14}	porcelain china & diamond	insulator
10^{12}		
	Bakelite®	
10^{10}		
10^{8}		
	aqua destillata	
10^{6}		
	Si (genuineness)	
10^{4}		
	cuprous oxide	
	Se	semiconductor
10^{2}		
	Ge (genuineness)	
10^{0}		
10^{-2}		
	black lead	
10^{-4}	nickel-chrome & Hg	conductor
	Pt, Sn, & Pb	
	Ag & Cu	
10^{-6}		

Fig. 1.1 resistivities of various substances at room temperature

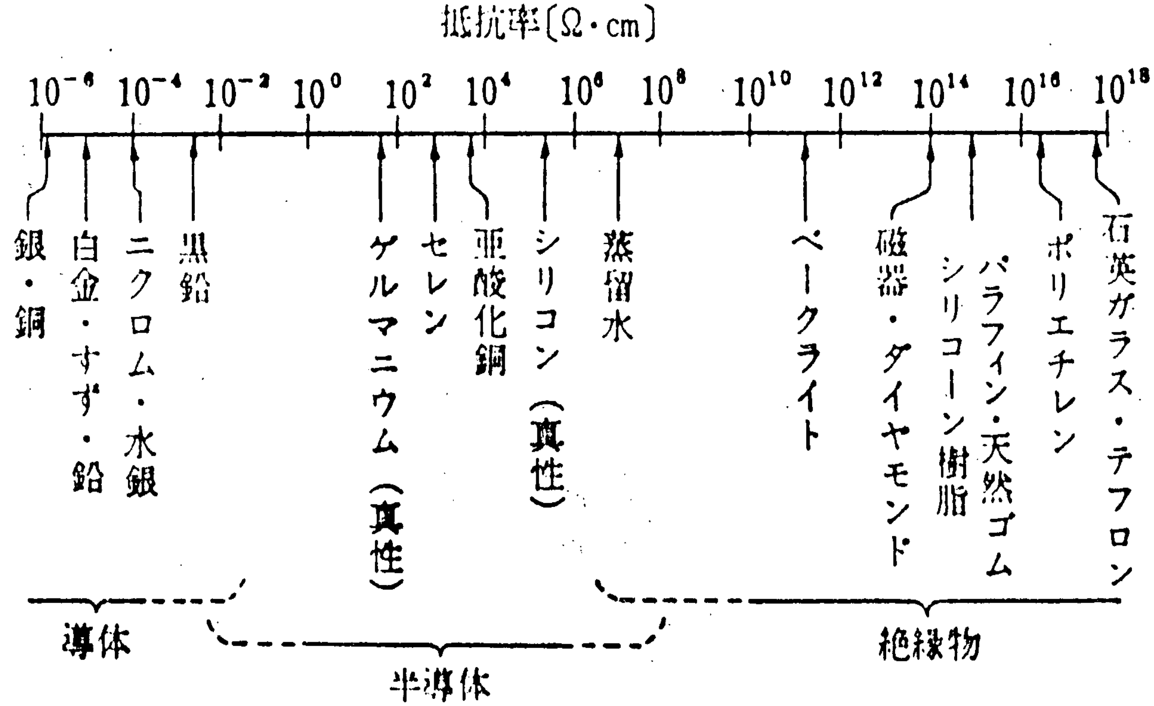

図 1·1 種々の物質の室温における抵抗率

Fig. 1.1

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"Introductory technology explanatory -Basic Theory of Semiconductor-" --Atsuo HOTTA-- issued by Gijutsu-Hyohron Co., Ltd. on October 10, 2000

Fig. 1.2 volume resistivity of semiconductor in the item 1.1 "Semiconductor definition" of the chapter 1 "semiconductor physics and PN junction"

Fig. 1.2 volume resistivity of semiconductor

glass natural rubber paraffin	Ge Si	Au, Ag, Cu Pb
insulator	Semiconductor	Conductor
10^{8} Ω·cm		10^{-8} Ω·cm

In lines 1-3 of page 13,

"In metal, the value of the volume resistivity is ~ 10^{-6} Ω·cm. In insulator, the value of the volume resistivity is ~ 10^{8} Ω·cm to ~ 10^{18} Ω·cm. In semiconductor, the value of the volume resistivity is ~ 10^{-2} Ω·cm to ~ 10^{18} Ω·cm."

Exhibit 2

"Introductory technology explanatory -Basic Theory of Semiconductor"

入門技術解説 半導体の基礎理論

堀田 厚生 著 ／ A5判 ／ 304ページ
ISBN4-7741-1081-7 ／ 2000年10月10日発売
定価2415円（本体2300円）

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▼ 目次

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PART 1

第1章 半導体の物理と PN接合

1.1 半導体の定義

なぜ半導体と呼ばれるのか

世の中に存在する固体物質を電気をよく通す導体(金属)と電気を通さない絶縁体に分けたとき、電気を少し通すのでどちらにも分類できない物質がある。それを半導体と呼ぶ。

物質の電気を通さない度合いを表すのに抵抗率を用いる。ある物質の1(cm)角の直方体の対向する2つの面に電圧をかけて、1(A)の電流が対向する面の間で均一に流れるようにする。そのとき、両端に印加される電圧を ρ (V)とするとその物質の体積抵抗率は ρ (Ω·cm：オームセンチメートル)となる。

図1-1●体積抵抗率の測定法

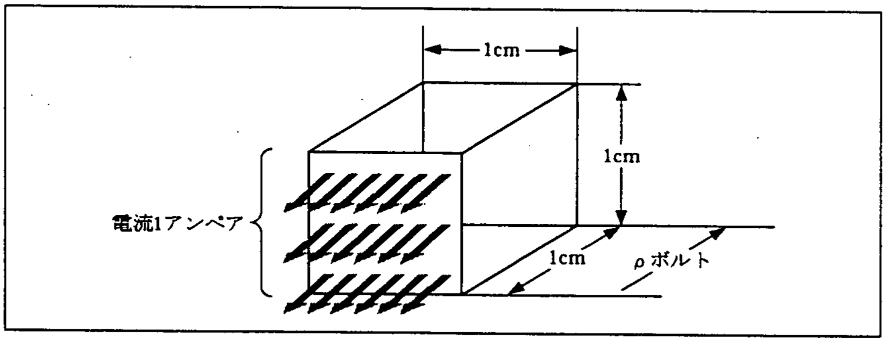

図1-2●半導体の体積抵抗率

ガラス 天然ゴム パラフィン	ゲルマニウム シリコン	金、銀、銅、 鉛
絶縁体	半導体	導体
10^8Ω・cm		10^{-6}Ω・cm

Fig. 1.2 volume resistivity of semiconductor

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金属ではこの値が～$10^{-6}(\Omega\cdot cm)$である。絶縁体では、～10^{8}―～10^{18}となる。半導体は～10^{-2}―～$10^{8}(\Omega\cdot cm)$である。したがって、絶縁体に近い体積抵抗率を示すものもある。なお、半導体に不純物を加えてゆくと体積抵抗率は下がる。

1.2 半導体の物質

どんな物質からなっているのか

世の中で半導体と呼ばれているものの大半はシリコン(Si：珪素ともいう)を素材としている。シリコン原子が規則正しく、立体格子状に並んだ物質(これを単結晶と呼ぶ)を用いる(シリコンの純粋な結晶はほとんど電気を通さない)。

シリコンは周期表(図1-3参照)のⅣ族に属していて、原子核の周りに合計14個の電子を持っている(図1-4)。最も外側(最外殻)に4個の電子(価電子)が存在し、これがシリコンの性質を決めている。同じⅣ族に属する炭素(C)やゲルマニウム(Ge)も原子の最外殻に4個の電子を持っており、シリコンと似た化学的性質を示す。これらの原子が同じⅣ族に分類される理由である。

図1-3●周期表

周期	1族	2族	3族	4族	5族	6族	7族	0族
1	1 H							2 He
2	3 Li	4 Be	5 B $2s^2 2p$	6 C $2s^2 2p^2$	7 N $2s^2 2p^3$	8 O	9 F	10 Ne
3	11 Na	12 Mg	13 Al $3s^2 3p$	14 Si $3s^2 3p^2$	15 P $3s^2 3p^3$	16 S	17 Cl	18 Ar
4	19 K	30 Zn	31 Ga $4s^2 4p$	32 Ge $4s^2 4p^2$	33 As $4s^2 4p^3$	34 Se	35 Br	36 Kr
5	37 Rb	48 Cd	49 In $5s^2 5p$	50 Sn $5s^2 5p^2$	51 Sb $5s^2 5p^3$	52 Te	53 I	54 Xe
6	55 Cs	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn

この間に多くの元素がある。

電子の個数

$3s^2 3p^2$

軌道

原子番号

半導体に関係する原子

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